

APPENDIX II

QUANTUM ELECTRODYNAMICS (QED) IS PURELY MATHEMATICAL AND HAS NO BASIS IN REALITY

The spin of the electron and the Lamb shift are calculated from first principles in closed form by Mills as shown in the Electron g Factor section and the Resonant Line Shape and Lamb Shift section, respectively. The spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p}$, can be applied directly to the wave function (a current density function) that describes the electron. The Lamb shift results from conservation of linear momentum of the photon. The Casimir effect is predicted by Maxwell's equations. These results demonstrate that QED has no basis in reality.

Quantum mechanics failed to predict the results of the Stern-Gerlach experiment which indicated the need for an additional quantum number. Quantum electrodynamics was proposed by Dirac in 1926 to provide a generalization of quantum mechanics for high energies in conformity with the theory of special relativity and to provide a consistent treatment of the interaction of matter with radiation. It relies on the unfounded notions of negative energy states of the vacuum, virtual particles, and gamma factors. From Weisskopf [41, refers to reference number shown below], "Dirac's quantum electrodynamics gave a more consistent derivation of the results of the correspondence principle, but it also brought about a number of new and serious difficulties." Quantum electrodynamics; 1.) does not explain nonradiation of bound electrons; 2.) contains an internal inconsistency with special relativity regarding the classical electron radius—the electron mass corresponding to its electric energy is infinite; 3.) it admits solutions of negative rest mass and negative kinetic energy; 4.) the interaction of the electron with the predicted zero-point field fluctuations leads to infinite kinetic energy and infinite electron mass; 5.) Dirac used the unacceptable states of negative mass for the description of the vacuum; yet, infinities still arise. In 1947, contrary to Dirac's predictions, Lamb discovered a 1000 *MHz* shift between the $^2S_{1/2}$ state and the $^2P_{1/2}$ state of the hydrogen atom [42]. This so called Lamb Shift marked the beginning of modern quantum

electrodynamics. In the words of Dirac [43], "No progress was made for 20 years. Then a development came initiated by Lamb's discovery and explanation of the Lamb Shift, which fundamentally changed the character of theoretical physics. It involved setting up rules for discarding ...infinities..." Renormalization is presently believed to be required of any fundamental theory of physics [44]. However, dissatisfaction with renormalization has been expressed at various times by many physicists including Dirac [45] who felt that, "This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it turns out to be small—not neglecting it just because it is infinitely great and you do not want it!"

Throughout the history of quantum theory; wherever there was an advance to a new application, it was necessary to repeat a trial-and-error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of QED. The QED method of the determination of $(g - 2)/2$ from the *postulated* Dirac equation is based on a *postulated* powers series of α/π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term which is processed over decades using ad hoc rules to remove infinities from each term that arises from *postulated* scores of *postulated* Feynman diagrams. Mohr and Taylor reference some of the Herculean efforts to arrive at g using QED [46]:

"the sixth-order coefficient $A_1^{(6)}$ arises from 72 diagrams and is also known analytically after nearly 30 years of effort by many researchers [see Roskies, Remiddi, and Levine (1990) for a review of the early work]. It was not until 1996 that the last remaining distinct diagrams were calculated analytically, thereby completing the theoretical expression for $A_1^{(6)}$ ".

For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally

valid. For example, Milonni [47] presents a QED derivation of the magnetic moment of the electron which gives a result of the wrong sign and requires the introduction of an

"upper limit K in the integration over $k = \omega / c$ in order to avoid a divergence."

A differential mass is arbitrarily added, then

"the choice $K = 0.42mc / \hbar$ yields $(g - 2)/2 = \alpha / 2\pi$ which is the relativistic QED result to first order in α . [...] However, the reader is warned not to take these calculations too seriously, for the result $(g - 2)/2 = \alpha / 2\pi$ could be obtained by retaining only the first (radiation reaction) term in (3.112) and choosing $K = 3mc / 8\hbar$. It should also be noted that the solution $K \cong 0.42mc / \hbar$ of (3.112) with $(g - 2)/2 = \alpha / 2\pi$ is not unique."

Such an ad hoc nonphysical approach makes incredulous:

" the cliché that QED is the best theory we have!" [48]

or the statement that:

"The history of quantum electrodynamics (QED) has been one of unblemished triumph" [49].

There is a corollary, noted by Kallen: from an inconsistent theory, any result may be derived.

The QED determination of the postulated power series in α / π is based on scores of Feynman diagrams corresponding to thousands of matrices with thousands of integrations per matrix requiring decades to reach a consensus on the "appropriate" algorithm to remove the intrinsic infinities. Remarkably, $(g - 2)/2$ may be derived in closed form from Maxwell's equations in a simple straightforward manner that yields a result with eleven figure agreement with experiment—the limit of experimental capability. Rather than an infinity of radically different QED models, an essential feature is that *Maxwellian solutions are unique*. The

derivation from first principles without invoking virtual particles, zero point fluctuations of the vacuum, and negative energy states of the vacuum is given in the Electron g Factor section.

Furthermore, Oskar Klein pointed out a glaring paradox implied by the Dirac equation which was never resolved [50]. "Electrons may penetrate an electrostatic barrier even when their kinetic energy, $E - mc^2$ is lower than the barrier. Since in Klein's example the barrier was infinitely broad this could not be associated with wave mechanical tunnel effect. It is truly a paradox: Electrons too slow to surpass the potential, may still only be partially reflected.

...Even for an infinitely high barrier, i.e. $r_2 = 1$ and energies $\approx 1 \text{ MeV}$, (the reflection coefficient) R is less than 75%! From (2) and (3) it appears that as soon as the barrier is sufficiently high: $V > 2mc^2$, electrons may transgress the repulsive wall-seemingly defying conservation of energy. ...Nor is it possible by way of the positive energy spectrum of the free electron to achieve complete Einstein causality."

The Rutherford experiment demonstrated that even atoms are comprised of essentially empty space [51]. Zero-point field fluctuations, virtual particles, and states of negative energy and mass invoked to describe the vacuum are nonsensical and have no basis in reality since they have never been observed experimentally and would correspond to an essentially infinite cosmological constant throughout the entire universe including regions of no mass. As given by Waldrop [52], "What makes this problem into something more than metaphysics is that the cosmological constant is observationally zero to a very high degree of accuracy. And yet, ordinary quantum field theory predicts that it ought to be enormous, about 120 orders of magnitude larger than the best observational limit. Moreover, this prediction is almost inescapable because it is a straightforward application of the uncertainty principle, which in this case states that every quantum field contains a certain, irreducible amount of energy even in empty space. Electrons, photons, quarks—the quantum field of every particle contributes. And that energy is exactly equivalent to the kind of pressure described by the cosmological constant. The cosmological constant has accordingly been an embarrassment and a frustration to every physicist who has ever grappled with it."

Furthermore, a consequence of the Heisenberg Uncertainty principle and QED is that matter may be created from nothing, including vacuum. Taking quantum theory into account, Stephen Hawking [53-54] mathematically proved that blackholes must emit Hawking radiation comprising photons, neutrinos, and all sorts of massive particles. "The surface emits with

equal probability all configurations of particles compatible with the observers limited knowledge. It is shown that the ignorance principle holds for quantum-mechanical evaporation of blackholes: The black hole creates particles in pairs, with one particle always falling into the hole and the other possibly escaping to infinity [54]." This QM theorem represents a perpetual motion machine with regard to spontaneous creation of mass and energy from the vacuum and with regard to gravitation. (QM also predicts a perpetual motion machine of the second kind [55-56]). Contrary to prediction, Hawking radiation has never been observed [57-59]. Classical laws including conservation of matter-energy are confirmed and QM is invalidated.

The Casimir effect is often touted as proof of that the vacuum is teeming with infinities of virtual particles. The experiment comprises a feeble force between two plates with precision machined surfaces that are brought within microns of contacting each other. The QED explanation of the weak force that is observed between the two plates is that the plates serve to limit the number of virtual particle modes between the plates as opposed to those outside the plates and the resulting imbalance in pressure between two infinite quantities gives rise to the feeble force [60].

The Casimir effect is predicted by Maxwell's equations and is not due to virtual particles. There is no reality to electromagnetic field zero point fluctuations and the implication that the Casimir force is an intrinsic property of space. The attractive force is due only to the interactions of the material bodies themselves. Lifshitz [61-62] first developed the theory of the attractive force between two plane surfaces made of a material with a general susceptibility. The Lifshitz calculation is developed from considerations of charge and current fluctuations in a material body. These fluctuations serve as a source term for Maxwell's equations, i.e. classical fields, subject to the boundary conditions presented by the body surfaces. In the limiting case of rarefied media, the van der Waals force of interaction between individual atoms is obtained.

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